

Checklist of vascular plants from Batu Caves, Selangor, Malaysia

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ABSTRACT: The vascular plant flora of Batu Caves, a tower karst limestone formation, includes 269 species; 51 species (19%) are Peninsular Malaysian endemics and 80 species (30%) are calciphiles of which 56 (21%) are obligate calciphiles and 26 species are obligate calciphiles endemic to Peninsular Malaysia. Four taxa are endemic to Batu Caves itself. That Batu Caves harbours a sizeable fraction (21.4%) of Peninsular Malaysia's limestone flora underlines the need for detailed checklists of each and every limestone hill to enable adequate planning of conservation programmes to support biodiversity. Because botanical collecting began in the 1890s, Batu Caves is important as the type locality of 24 plant species. Land-use pressures have over time eliminated the surrounding native vegetation, leaving the flora vulnerable to aggressive weedy and alien species. Although designated as a Public Recreation Area, its protection status needs to be enforced and the boundaries clearly marked.

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INTRODUCTION

Batu Caves (3°14' N, 101°41' E), or Gua Batu (in Malay), is a limestone tower karst formation 11 km northeast of the capital Kuala Lumpur. It rises to 329 m tall and covers about 2.59 km². This massif with its vertical cliffs and craggy summit is a dominant landscape feature. Batu Caves is most famous for the Sri Subramaniaswamy Temple that at the Thaipusam festival is visited by hundreds of thousands of devotees who climb the 277 steps up to the Temple Cave. Besides its cultural importance as a religious site, it is also important for its cave ecosystems and associated fauna (Moseley *et al.* 2012) and for its flora (Wycherley 1972).

Batu Caves has been exploited commercially for a very long time. At first by Chinese farmers who since the 1860s collected guano from the caves (Yussof 1997). Quarrying for limestone had already started by 1889 when H.N. Ridley first investigated the caves, flora and fauna. Although Batu Caves was designated as a Public Recreational Area in 1930, quarry licenses continued to be leased in spite of lobbying for the total protection of the massif by the Batu Caves Protection Association and the Malayan Nature Society. Only when quarrying caused rock falls in the Dark Cave adjacent to the Temple Cave did quarrying finally stop in 1981. Batu Caves is now surrounded by residential, light industry and temple buildings with very little if any of the original vegetation that surrounded the foot of the tower karst. Enforcement of its status as a Public Recreational Area is lacking and its boundaries are not clearly marked so that intrusions go unchecked.

The limestone flora in Malaysia is botanically important due to (a) its species richness—14% of Peninsular Malaysia's species occur on the 0.04% of land area that limestone covers (Chin 1977), the result of the many different microhabitats stacked on a single limestone hill (Kiew 1991); (b) it is distinctly different in species composition compared with other forest types both in its

common species, for example, species of Dipterocarpaceae, the dominant tree family in Malaysian rain forest, are hardly represented on limestone, and in calciphile species that are restricted to growing on limestone substrate, and (c) in its high level of endemism—21.4% of species (Chin 1977). Saw *et al.* (2009) considered that the limestone flora is one of the most endangered vegetation types in Peninsular Malaysia because of its lack of legal protection and threats from quarrying and disturbance resulting from land use changes.

H.J. Kelsall was the first collector of plants from Batu Caves when in 1891 he discovered three new species (*Adenoncos parviflora*, *Paraboea paniculata* and *P. verticillata*). Ridley has made the most comprehensive collections when he visited in June 1889, December 1896, July and August 1897, August 1908 and December 1920 and described many new species (Wycherley 1972). Then it was apparently easier to access the summit of Batu Caves, but since this time quarrying has left sheer rock faces where previously there were accessible gullies leading to the summit. Now the collector is faced by precipitous rock faces. Ridley collected at a time when Batu Caves was still surrounded by pristine lowland forest, although coffee plantations and later rubber tree plantations were expanding towards Batu Caves. This forest has long since been completely cleared causing the first recorded extinction of a plant species, *Echinodorus ridleyi* Steenis (Alismataceae), in Malaysia. To date, due to its proximity to Kuala Lumpur, more than 35 botanists have sporadically collected specimens from Batu Caves and their research continues to add new records. In fact, Batu Caves is probably the best collected tower karst hills in Peninsular Malaysia. Wycherley (1972) provided a partial list of 199 vascular plant species collected by Ridley.

The aim of this updated checklist is to consolidate what is known of the flora of Batu Caves both from the

many diverse literature sources as well as from herbarium specimens. This is necessary as a basis for drawing up conservation management programmes as well as for tracking the decline or loss of species and the invasion of aggressive alien or weedy species.

MATERIALS AND METHODS

The checklist is based on a search of the literature (Henderson 1939, Wycherley 1972, and Chin 1977, 1979, 1983a, b are major works, but there are also many specialist articles on specific species) and herbaria that house major collections of specimens collected from Batu Caves, namely The Singapore Herbarium, Singapore Botanic Gardens, Singapore (SING); the Kepong Herbarium, Forest Research Institute Malaysia, Kepong, Selangor (KEP); and the University of Malaya Herbarium, Kuala Lumpur (KLU). The collections at KEP and SING are partially databased using BRAHMS (Botanical Research and Herbarium Management System), which greatly facilitated extraction of data. Extraction of data from KLU was done manually from accession books. In the case of dubious identifications, the herbarium specimen was checked and the name corrected. Only species recorded from the tower karst or limestone-derived soil at the base are included. Thus forest species that Ridley collected are not included in the checklist, nor are weeds that grow on wasteland around Batu Caves, nor exotic aliens that have invaded disturbed areas at the foot of Batu Caves.

The checklist includes family and species names, cites specimens, provides the endemic status, whether endemic in Peninsular Malaysia (E) or endemic in the phytogeographic zone that straddles the border of Peninsular Malaysia and Peninsular Thailand (ET); and status as a calciphile, i.e. whether it is an obligate calciphile *restricted* to growing on limestone (R) or whether it is a characteristic species most *usually* found on limestone (U).

RESULTS

The checklist (Appendix 1) includes 5 lycophyte species, 27 ferns, 2 gymnosperms, 182 dicotyledons and 53 monocotyledons, in total 269 species. This represents 22% of 1,216 species recorded growing on limestone in Peninsular Malaysia (Chin 1977). The percentages of endemic and obligate and characteristic calciphiles (Table 1) are representative of the limestone flora as a whole.

The ten most common families are Orchidaceae (23 species), Apocynaceae (20 species), Rubiaceae (14 species), Araceae (12 species) and Gesneriaceae, Moraceae and Urticaceae (each represented by 9 species). *Ficus* (Moraceae) with 9 species is by far the largest genus.

Of the 56 species of obligate calciphiles (Appendix 1), 26 are endemic in Peninsular Malaysia and are therefore of highest conservation concern. Among these are:

- 4 local endemic species or varieties that are obligate calciphiles and are only known from Batu Caves—

Epithema parvibracteatum, *Pararuellia sumatrensis* var. *ridleyi*, *Pseuderanthemum lilacinum* and *Rhaphidophora burkillana*

- 3 local endemic species that are obligate calciphiles and are only known from Batu Caves and the nearby Bukit Takun and Bukit Anak Takun that lie about 10 km north of Batu Caves—*Maxburretia rupicola*, *Ophiorrhiza fruticosa* and *Paraboea paniculata*
- very rare species found on one or two other limestone hills, e.g., *Impatiens ridleyi* is known only from Batu Caves and from Gunung Senyum, Pahang.

Other rare species that are not obligate calciphiles but are of conservation importance are

- 4 narrowly endemic species confined to an area within 15 km from Batu Caves—*Begonia phoeniogramma*, *Beaumontia murdochii*, *Piper argyrites* and *Psychotria lanceolaria*
- 6 widespread species that in Peninsular Malaysia are known only from Batu Caves—*Piper mucronata*, *Pomatocalpa andamanica*, *Sageretia thea*, *Sapium insigne*, *Sauropus macranthus*, and *Trigonostemon villosus*.

Batu Caves is also important because it is the type locality for 24 taxa, even though some have since been reduced to synonymy.

DISCUSSION

Table 1 illustrates the fact that while the limestone flora is species rich (1,216 species), only a fraction are found on a single hill (21.4% of the species on Batu Caves) due in part to local endemism of the obligate calciphiles. This is illustrated by the Gesneriaceae. For the Peninsular limestone flora as a whole, Gesneriaceae is ranked fourth with 39 species but on Batu Caves it is represented by just seven species. Of these, only two grow on non-limestone substrates and are widely distributed; the rest are obligate calciphiles, two are local endemics, while the remaining three are more widespread but none are found on every hill. In fact it is the exception for limestone species to be encountered on every or even most hills. This is especially true among the obligate calciphiles. For instance, eight species of balsam are obligate calciphiles but only *Impatiens ridleyi* grows on Batu Caves and one other hill (Gunung Senyum, Pahang). The implications for conservation are two-fold. Firstly, to be able to make decisions on conservation management a detailed checklist for each hill is necessary and secondly, because each hill harbours only a fraction of the flora, a network of protected hills is required to capture the maximum biodiversity of the limestone flora.

Among the 267 species recorded from Batu Caves, 16 taxa (6%) are of conservation importance, either because they are local endemics that are restricted to just Batu Caves (4 species) or within 15 km of Batu Caves (3

TABLE 1. Number of taxa on Batu Caves compared with the total Peninsular Malaysia limestone flora.

	Total No. Species	No. and percentage of endemic species	No. and percentage of obligate (R) and characteristic (U) calciphile species
Batu Caves	269	51 (19%)	80 (30%)
Limestone Flora ¹	1,216	261 (21.4%)	335 (27.5%)

¹Data from Chin 1977.



restricted to limestone and 4 on both limestone and non-limestone substrates) and 6 are widespread elsewhere but in Peninsular Malaysia are known only from Batu Caves.

Because Ridley was collecting when the flora of Peninsular Malaysia was just beginning to be known, many new species were described from Batu Caves (Table 2). From the scientific point of view, Batu Caves is important as a living museum where scientists are able to obtain living material of the authentic specimens from the type locality, for example, for DNA analysis, breeding and other investigations.

Although the Batu Caves tower karst formation has remained largely intact in spite of quarrying activity, the surrounding area has completely changed from pristine forest when Kelsall and Ridley made their collections, to the establishment of plantations that in turn were replaced by residential and industrial buildings and expanding infrastructure associated with the Sri Subramaniaswamy Temple. While the summit and flanks are largely undisturbed, the habitats around the base and associated with the Temple Cave are under severe pressure. This puts at risk populations of sensitive species that require moist shaded conditions, such as *Argostemma inaequilaterum*, which used to grow at the cliff base near the Art Gallery Caves; *Impatiens ridleyi* that only grows around the mouth of the Temple Cave where water constantly drips down; and *Epithema parvibracteatum* and *Monophyllaea hirticalyx* that grow on the rock scree below the skylight at the back of the Temple Cave. The latter species has not been seen for some years. With the removal of tree cover, aggressive invasive species both native, e.g. species of *Macaranga* and *Mallotus* (Euphorbiaceae) and of alien origin, e.g., *Piper aduncum* L. and *Chromolena odoratum* (L.) R.M. King & H. Rob. form thickets that smother the native flora. Of particular concern is *Chromolena* that in

dry weather becomes a fire risk. Recently human activity resulted in vegetation fires on one face of the tower karst. Active conservation management is required to protect these habitats from disturbance that not only drastically changes the microclimate but allows the invasion of these aggressive alien species. To protect the limestone flora there is an urgent need to clearly fence off the Public Recreation Area to prevent further intrusions.

Conclusion

Batu Caves is one of the iconic tower karsts in Peninsular Malaysia not only for its dominance of the landscape, but also for its Temple Cave that attracts hundreds of thousands of devotees. Scientifically it is important for its biodiverse flora, fauna and for its caves. Its flora is important in being species rich, including a high proportion of endemic and obligate and characteristic calciphiles, including taxa that are known only from Batu Caves, besides its historic importance as a type locality.

In view of the pressure on land from its proximity to the capital, Kuala Lumpur, there is an urgent need to enforce its legal protection status, to make clear the boundary of the Public Recreation Area, and to provide a buffer zone, preferably of tree cover, to protect the sensitive habitats at the foot of the cliffs and to provide a barrier to fire.

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TABLE 2. Species for which Batu Caves, Selangor, Malaysia, is the type locality.

ORIGINAL NAME	CURRENT NAME IF REDUCED TO SYNONOMY
<i>Adenoncos parviflora</i>	
<i>Alyxia selangorica</i> King	<i>Alyxia pilosa</i>
<i>Andrachne calcarea</i> Ridl.	<i>Leptopus australis</i>
<i>Aporuellia sumatrensis</i> C.B.Clarke var. <i>ridleyi</i> C.B.Clarke	<i>Pararuellia sumatrensis</i> var. <i>ridleyi</i>
<i>Begonia phoeniogramma</i>	
<i>Boea paniculata</i> Ridl.	<i>Paraboea paniculata</i>
<i>Boea verticillata</i> Ridl.	<i>Paraboea verticillata</i>
<i>Bulbophyllum flammuliferum</i>	
<i>Cnesmone subpeltata</i>	
<i>Epithema parvibracteatum</i>	
<i>Hoya occlusa</i> Ridl.	<i>Hoya coriacea</i>
<i>Impatiens ridleyi</i>	
<i>Justicia microcarpa</i> Ridl.	<i>Rungia laxiflora</i>
<i>Livistona rupicola</i> Ridl.	<i>Maxburretia rupicola</i>
<i>Ophiorrhiza fruticosa</i>	
<i>Pavetta pauciflora</i>	
<i>Phyllanthus erythrocarpus</i>	
<i>Pilea calcarea</i> Ridl.	<i>Pilea fruticosa</i>
<i>Polyalthia congregata</i>	<i>Enicosanthum congregatum</i>
<i>Polytrema aequala</i> Ridl.	<i>Ptyssiglottis kunthiana</i>
<i>Pothos lorispatha</i> Ridl.	<i>Pothos leptostachyus</i>
<i>Pseuderanthemum lilacinum</i>	
<i>Psychotria lanceolaria</i>	
<i>Rhaphidophora burkillana</i>	

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APPENDIX 1. Checklist of Vascular Plants from Batu Caves, Selangor, Malaysia. (E endemic in Peninsular Malaysia; ET endemic in Peninsular Malaysia and Peninsular Thailand; R obligate calciphile, U characteristic species, usually found on limestone

FAMILY/ SPECIES	ENDEMISM E/TE	CALCIPHILE STATUS U/R	COLLECTOR, NUMBER
Lycophytes			
Selaginellaceae			
<i>Selaginella alutacia</i> Spring.			Ridley 8150
<i>Selaginella mayeri</i> Hieron			Foxworthy FMS 23243; Ezzawanis FRI 52478; Schuettpelz 711
<i>Selaginella padangensis</i> Hieron			Ridley 8667; Lee s.n.
<i>Selaginella stipulata</i> (Blume) Spring.			Ugul & Bala KLU 21964; Schuellpelz 712
<i>Selaginella willdenowia</i> (Desv. ex Poir.) Baker			Chin 325
Ferns			
Adiantaceae			
<i>Adiantum capillus-veneris</i> L.			Schuettpelz 705
<i>Adiantum malesianum</i> Ghatak.		R	Ridley 8142; Ding DH 712; Sinclair SFN 40058; Ezzawanis FRI 52477
Aspleniaceae			
<i>Asplenium cheilosorum</i> Kunze ex Mett.			Schuettpelz 707
<i>Asplenium macrophyllum</i> Sw.			Sinclair SFN 40056
<i>Asplenium polyodon</i> G.Forst.		U	Stone 7294
<i>Asplenium vittiforme</i> Cav.			Chin 321
Lomariopsidaceae			
<i>Cyclopeltis crenata</i> (Fee) C.Chr.		U	Strugnell FMS 14617, 14622
Nephrolepidaceae			
<i>Nephrolepis falciformis</i> J.Sm.		U	Ding DH 714; Ezzawanis FRI 52481
Polypodiaceae			
<i>Microsorium membranifolium</i> (R.Br.) Ching			Nor-Ezzawanis FRI 52480; Schuettpelz 709
<i>Pyrossia stigmosa</i> (Sw.) Ching		R	Merton 4103
Pteridaceae			
<i>Pteris ensiformis</i> Burm.f.			Allen 2323
<i>Pteris venulosa</i> Blume			Schuettpelz 710
<i>Pteris vittata</i> L.			Abdul-Samat 336; Schuettpelz 713
Schizaeaceae			
<i>Actinostachys inopinata</i> (Selling) Reed		R	Wyatt-Smith KEP 85208
Sinopteridaceae			
<i>Calciphilopteris allenae</i> (Tryon)	E	R	Chin 1270; Kiew RK 1618; Saw FRI 48231
<i>Calciphilopteris ludens</i> (Wall. ex Hook.)		R	Ridley 8135; Ding DH 709
<i>Hemionitis arifolia</i> (Burm.f.) T.Moore		U	Strugnell FMS 17078
Tectariaceae			
<i>Heterogonium pinnatum</i> (Copel.) Holttum		U	Sinclair SFN 40062; Schuettpelz 708
<i>Tectaria</i> sp.			Schuettpelz 704, 706
<i>Tectaria devexa</i> (Kunze) Copel.		R	Molesworth-Allen 2356; Sinclair SFN 40052
<i>Tectaria keckii</i> (Luersson) C.Chr.		R	Molesworth-Allen 2395; Strugnell FMS 14615
Thelypteridaceae			
<i>Amphineuron immersum</i> (Blume) Holttum			Schuettpelz 714
<i>Amphineuron opulentum</i> (Kaulf.) Holttum			Viane & Noe 2325
<i>Pronephrium triphyllum</i> (Sw.) Holttum			Viane & Noe 2328
Vittariaceae			
<i>Antrophyum parvulum</i> Blume		U	Ridley 8644; Kiew, B.H. RK 1343; Sinclair SFN 40070
Woodsiaceae			
<i>Diplazium esculentum</i> (Retz.) Sw.			Molesworth-Allen 1350

FAMILY/ SPECIES	ENDEMISM E/TE	CALCIPHILE STATUS U/R	COLLECTOR, NUMBER
<i>Diplazium pallidum</i> (Blume) T. Moore			Ridley s.n. 1896
Gymnosperms			
Podocarpaceae			
<i>Podocarpus neriifolius</i> D.Don			Wyatt-Smith KEP 93281; Ng FRI 1633
<i>Podocarpus polystachyus</i> R.Br. ex Endl.		U	Ng FRI 1634
Dicotyledons			
Acanthaceae			
<i>Justicia uber</i> C.B.Clarke	E		Strugnell FMS 14618
<i>Pararuellia sumatrensis</i> (C.B.Clarke) Bremek. var. <i>ridleyi</i> (C.B.Clarke) Bremek.	E	R	Ridley 8213, Strugnell FMS 17079; Kiew FRI 48226
<i>Pseuderanthemum crenulatum</i> (Lindl.) Radlk.			Mohd Kasim 500
<i>Pseuderanthemum lilacinum</i> Stapf	E	R	Ridley s.n.
<i>Ptyssiglottis kunthiana</i> (Nees) B.Hansen		U	Ridley s.n. 1914
<i>Rungia laxiflora</i> C.B.Clarke	ET		Ridley 8213
Actinidaceae			
<i>Sauria leprosa</i> Korth.			Ridley 8269
<i>Sauria pentapetala</i> (Jack) Hoogland			Ridley s.n. 1921
Anacardiaceae			
<i>Pistacia malayana</i> M.R. Hend.	E	R	Whitmore FRI 758
Annonaceae			
<i>Enicosanthum congregatum</i> (King) Airy Shaw	E		Ridley s.n.
<i>Goniothalamus macrophyllus</i> (Blume) Hook.f. & Thomson			Syahida-Emiza FRI 66738
<i>Polyalthia brunneifolia</i> J.Sinclair	E		Whitmore FRI 757
<i>Polyalthia jenkinsii</i> (Hook.f. & Thomson)Hook.f. & Thomson			Bowen 8483
<i>Polyalthia obliqua</i> Hook.f. & Thomson			Whitmore 79243
<i>Sageraea elliptica</i> (A.DC.) Hook.f. & Thomson			Stone 1266
<i>Trivalvaria macrophylla</i> (Blume) Miq.			Wyatt-Smith FMS 30781; Chin SFN 40060
<i>Uvaria grandiflora</i> Roxb. ex Hornem. var. <i>grandiflora</i>			Symington FRI 66730
<i>Uvaria javana</i> Dunal			Sinclair FRI 700
Apocynaceae			
<i>Alstonia scholaris</i> (L.) R.Br.			Hamid FMS 6443
<i>Alyxia angustifolia</i> Ridl.	E		Wyatt-Smith KEP 79250
<i>Alyxia pilosa</i> Miq.			Ridley 8558
<i>Beaumontia murtonii</i> Craib			Wyatt-Smith FRI 76343; Saw FRI 48223
<i>Dischidia hirsuta</i> (Blume) Decne.			Rintz RER 110
<i>Gymnema</i> sp.			Rintz RER 10
<i>Heterostemma piperifolium</i> King & Gamble	E	U	Burkill SFN 2261
<i>Hoya coriacea</i> Blume			Ridley s.n. 1890
<i>Hoya finlaysonii</i> Wight			Rintz RER 107
<i>Hoya verticillata</i> (Vahl.) G.Don var. <i>citrina</i> (Ridl.) Veldkamp	E	U	Rintz RER 111
<i>Hunteria zeylanica</i> (Retz.) Gardn. ex Thwaites			Ridley 8556
<i>Kopsia griffithii</i> King & Gamble var. <i>griffithii</i>			Ezzawanis FRI 52482
<i>Mardenia ridleyi</i> P.I.Forst.	E		Rintz RER 109
<i>Marsdenia tinctoria</i> R.Br.		U	Ridley s.n.; Burkill SFN 6356
<i>Secamone elliptica</i> R.Br.			Chin 351; Rintz RER 12, 59
<i>Tabernaemontana peduncularis</i> Wall.			Ridley 8555
<i>Toxocarpus curtisii</i> King & Gamble			Rintz RER 112
<i>Toxocarpus griffithii</i> Decne.			Ridley 1897
<i>Toxocarpus pauciflora</i> M.R.Hend.	E	R	Chin 353
<i>Tylophora flexuosa</i> R.Br.	E	R	Burkill SFN 6351
Araliaceae			
<i>Schefflera oxyphylla</i> (Miq.) R.Vig.			Symington KEP 32652; Whitmore FRI 15634
Balsaminaceae			
<i>Impatiens ridleyi</i> Hook.f.	E	R	Ridley 8278; Anthonysamy SA 380; Kiew RK 4706
Begoniaceae			
<i>Begonia kingiana</i> Irmsch.	E	R	Burkill 2263; Kiew, B.H. RK 1341
<i>Begonia phoeniogramma</i> Ridl.	E		Ridley 13430; Sinclair SFN 40067; Kiew RK 1257; Symington KEP 32656

FAMILY/ SPECIES	ENDEMISM E/TE	CALCIPHILE STATUS U/R	COLLECTOR, NUMBER
Bignoniaceae			
<i>Radermachera glandulosa</i> (Blume) Miq.			Ridley 8537
Boragineaceae			
<i>Ehretia timorensis</i> Decne.			Chin 1248
Capparaceae			
<i>Capparis pubiflora</i> DC.			Burkill SFN 6369
Celastraceae			
<i>Euonymus javanicus</i> Blume			Symington KEP 30800
<i>Glyptopetalum quadrangulare</i> Prain ex King			Chin 334
<i>Loeseneriella cumingii</i> Laws.			Wyatt-Smith 76342; Sinclair SFN 40054
<i>Maytenus curtisii</i> (King) Ding Hou	ET	R	Chin 1261
<i>Salacia macrophylla</i> Blume			Wyatt-Smith KEP 79149
Chloranthaceae			
<i>Chloranthus erectus</i> (Buch.-Ham.) Verdc.			Chin 1666
Convolvulaceae			
<i>Argyreia kunstleri</i> (Prain) Prain ex Ooststr.	E		Ridley 8220
<i>Erycibe rheedii</i> Blume			Burkill SFN 6365
<i>Lepistemon binectiferum</i> (Wall.) Kuntze			Ridley s.n.; Stone 8976
Cucurbitaceae			
<i>Bayabusua clarkei</i> (King) W.J. de Wilde	E		Ridley 8275
<i>Coccinia grandis</i> (L.) Voight			Syahida-Emiza FRI 66740
<i>Melothria pendula</i> L.		R	Chew FRI 51926
<i>Momordica cochinchinensis</i> (Lour.) Spreng.			Ridley 8277
<i>Neoalsomitra clavigera</i> (Wall.) Hutch.			Syahida-Emiza FRI 66732
<i>Scopellaria marginata</i> (Blume) W.J. de Wilde & Duyfjes			Ridley 8280
Dilleniaceae			
<i>Dillenia excelsa</i> (Jack) Gilg			Ng FRI 27201
Dipterocarpaceae			
<i>Anisoptera costata</i> Korth.			Strugnell 17073
<i>Hopea dryobalanoides</i> Miq.			Wyatt-Smith KEP 98274
Ebenaceae			
<i>Diospyros kurzii</i> Hiern.			Sinclair SFN 40055; Wyatt-Smith KEP 76341
Elaeocarpaceae			
<i>Elaeocarpus pedunculatus</i> Wall. Ex Mast.			Chin 1262
Erythroxylaceae			
<i>Erythroxylum cuneatum</i> (Miq.) Kurz			Ng FRI 1636
Euphorbiaceae			
<i>Bridelia tomentosa</i> Blume			Stone 8978
<i>Cnesmone subpeltata</i> Ridl.	E	R	Whitmore FRI 751
<i>Homalanthus populneus</i> (Grisel.) Pax			Sinclair SFN 40074
<i>Macaranga tanarius</i> (L.) M.A.			Whitmore FRI 754
<i>Mallotus dispar</i> (Blume) M.A.		U	Strugnell FMS 14619; Symington FMS 32653; Wyatt-Smith KEP 94598
<i>Mallotus repandus</i> (Willd.) M.A.			Symington FMS 30793, 32654
<i>Sapium insigne</i> (Royle) Benth.		R	Ng FRI 1626
<i>Trigonostemon villosus</i> Hook.f.			Whitmore FRI 1752
Gentianaceae			
<i>Duplipetala pentanthera</i> (C.B.Clarke) Thiv.		U	Ridley 8218; Kiew RK 1617
<i>Fagraea carnos</i> a Jack		U	Wyatt-Smith KEP 85211
<i>Fagraea ceilanica</i> Thunb.			Ng FRI 1627
Gesneriaceae			
<i>Cyrtandra pendula</i> Blume			Kiew, B.H. RK 1344
<i>Epithema parvibracteatum</i> Hilliard & B.L.Burt	E	R	Ridley 8217; Siti-Munirah FRI 70502
<i>Microchirita caliginosa</i> (C.B.Clarke) Y.Z.Wang		R	Anthony
<i>Monophyllaea hirticalyx</i> Franch.	E	R	Chin 2107
<i>Monophyllaea horsfieldii</i> R.Br.			Anthony
<i>Paraboea paniculata</i> (Ridl.) B.L.Burt	E	R	Ridley 8226; Kelsall 1970; Wyatt-Smith KEP 79245; Yusof 02
<i>Paraboea verticillata</i> (Ridl.) B.L.Burt	E	R	Ridley 8551; Kelsall s.n.; Ng FRI 1628; Kiew FRI 48225
Guttiferae			
<i>Garcinia murdochii</i> Ridl.			Chin 1253

FAMILY/ SPECIES	ENDEMISM E/TE	CALCIPHILE STATUS U/R	COLLECTOR, NUMBER
Labiatae			
<i>Callicarpa angustifolia</i> King & Gamble		R	Wyatt-Smith KEP 79249; Ng FRI 1637; Saw FRI 48230
<i>Clerodendrum deflexum</i> Wall.			Ridley s.n.; Wyatt-Smith KEP 79247
Lauraceae			
<i>Cryptocarya griffithiana</i> Wight			Chin 1246
<i>Dehaasia pauciflora</i> Blume			Chin 328
<i>Litsea angulata</i> Blume			Ridley 8505
Lecythidaceae			
<i>Barringtonia fusiformis</i> King			Ridley 8284
Leguminosae			
<i>Derris trifoliata</i> Lour.			Stone 8980
<i>Pterolobium densiflorum</i> Prain			Whitmore FRI 15635
Melastomataceae			
<i>Pogonantha pulverulenta</i> (Jack) Blume			Wyatt-Smith KEP 85210
Meliaceae			
<i>Aglaia teysmanniana</i> (Miq.) Miq.			Chin 1245; Putz FRI 23689
<i>Chisocheton patens</i> Blume			Ridley 8609
<i>Chukrasia tabularis</i> A.Juss.			Wyatt-Smith FRI 76344
Memecylonaceae			
<i>Memecylon lilacinum</i> Zoll. & Moritzi			Ridley 8279
<i>Memecylon ovatum</i> Sm.			Chin 313
<i>Memecylon scutellatum</i> var. <i>brevifolium</i>			Ridley s.n.
Menispermaceae			
<i>Cyclea laxiflora</i> Miers			Whitmore FRI 759
Moraceae			
<i>Ficus calcicola</i> Corner		R	Whitmore FRI 15633
<i>Ficus callophylla</i> Blume			Ng FRI 1635
<i>Ficus hispida</i> L.f.			Symington FMS 30790
<i>Ficus lepicarpa</i> Blume			Ridley 8185
<i>Ficus punctata</i> Thunb.			Ridley 8501
<i>Ficus sagittata</i> Vahl.			Ridley 8524, 13374
<i>Ficus schwarzii</i> Koord.			Ridley 8188
<i>Ficus subulata</i> Blume			Symington FMS 30773
<i>Ficus sundaica</i> Blume			Ridley s.n.; Chin 1272
Myrsinaceae			
<i>Ardisia</i> sp. Z TFM 4:273	E		Symington KEP 30799
Myrtaceae			
<i>Rhodamnia cinerea</i> Jack			Chin 1255
<i>Syzygium scortechinii</i> (King) P. Chantaranothai var. <i>cuneatum</i> (M.R.Hend.) I.M.Turner	E		Symington FMS 30791
<i>Syzygium stapfianum</i> (King) I.M.Turner	E		Wyatt-Smith KEP 80267
Olacaceae			
<i>Strombosia ceylanica</i> Gardn.			Ridley 8150
<i>Strombosia javanica</i> Blume			Ridley 8267
Oleaceae			
<i>Jasminum cordatum</i> Ridl.	ET	R	Chin 359; Syahida-Emiza FRI 66737
<i>Ligustrum confusum</i> Decne.		R	Ding Hou 704; Kiew RK 1615
Pandaceae			
<i>Microdesmis caseariifolia</i> Hook.f. ex Planch.			Symington FMS 30783
Phyllanthaceae			
<i>Actephila excelsa</i> (Dalz.) M.A. var. <i>acuminata</i> Airy Shaw		R	Chin s.n.
<i>Glochidion obscurum</i> (Roxb.) ex Willd.)			Chin 472
<i>Glochidion rubrum</i> Blume			Chin s.n.
<i>Leptopus australis</i> (Zoll. & Mor.) Pojarkova		R	Ridley 8203
<i>Phyllanthus oxyphyllus</i> Miq.			Ridley 8174
<i>Phyllanthus reticulatus</i> Poir.			Ridley s.n.
<i>Sauropus androgynus</i> (L.) Merr.			Syahida-Emiza FRI 66734
<i>Sauropus macranthus</i> Hassk.		R	Ridley 8183, 8257
Piperaceae			
<i>Peperomia portulacoides</i> (Lam.) A. Dietr.		R	Kelsall s.n. 1891; Ridley 19446
<i>Piper argyrites</i> Ridl.	E		Ridley s.n.

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<i>Piper kurzii</i> Ridl.	E		Ridley 8180
<i>Piper mucronatum</i> C.DC.			Poore 807
<i>Piper umbellatum</i> L.			Symington FMS 30794
Rhamnaceae			
<i>Sageretia thea</i> (Osbeck) M.C.Johnst.		R	Whitmore FRI 15627; Ng FRI 1638
<i>Ventilago oblongifolia</i> Blume	E	R	Chin 344
<i>Zizyphus pernettyoides</i> Ridl.			Chin 343
Rhizophoraceae			
<i>Carallia brachiata</i> (Loir.) Merr.			Ridley 8265
Rubiaceae			
<i>Aidia densiflora</i> (Wall.) Masam.	E		Whitmore FRI 755, 15632
<i>Argostemma diversifolium</i> Ridl.		R	Teruya 500
<i>Argostemma inaequilaterum</i> Benn.		U	Ridley 8233; Symington KEP 30789
<i>Chassalia</i> sp.			Chin 474
<i>Mycetia malayana</i> (Wall. Ex Ridl.) Craib		U	Hamid KEP 7011
<i>Ophiorrhiza discolor</i> R.Br.			Ridley s.n.
<i>Ophiorrhiza fruticosa</i> Ridl	E	R	Ridley 8237, 8274; Ng FRI 1639
<i>Ophiorrhiza pallidula</i> Ridl.	E		Ridley s.n.
<i>Pavetta pauciflora</i> Ridl.	E	R	Ridley s.n. 1920
<i>Psychotria lanceolaria</i> Ridl.	E		Ridley s.n.
<i>Psychotria penangiana</i> Hook.f.	E		Strugnell KEP 17081
<i>Tarenna adangensis</i> (Ridl.) Ridl.		R	Ding DH 708
<i>Tarenna angustifolia</i> (King) Merr.		R	Wyatt-Smith KEP 79248; Whitmore FRI 15628; Syahida-Emiza FRI 66731
<i>Tarenna</i> sp. 16	E	R	Chin 1249
Rutaceae			
<i>Clausena excavata</i> Burm.f.			Chin 345
<i>Glycosmis chlorosperma</i> Spr.			Symington FMS 30792
<i>Glycosmis trichanthera</i> Guillaumin var. <i>trichanthera</i>		R	Wyatt-Smith KEP 85207; Stone 8977
<i>Paramignya scandens</i> (Griff.) Craib	E		Stone 8981
Salicaceae			
<i>Osmelia maingayi</i> King			Ridley 8593
<i>Scolopia spinosa</i> (Roxb.) Warb.			Chin 354
Sapindaceae			
<i>Allophylus cobbe</i> (L.) Raeusch.			Ridley s.n.
<i>Dimocarpus longan</i> Lour. subsp. <i>malesianus</i> Leenh.		R	Curtis 3773
Sapotaceae			
<i>Pouteria obovata</i> (R.Br.) Baehni			Ng FRI 1623
Solanaceae			
<i>Lycianthes biflora</i> (Lour.) Bitter		U	Wyatt-Smith KEP 79150
<i>Solanum erianthum</i> D.Don			Merton 4105
Sterculiaceae			
<i>Pterospermum acerifolium</i> (L.) Willd.			Wyatt-Smith KEP 79246; Symington FMS 30782
<i>Sterculia</i> sp.			Chin 1263
Ulmaceae			
<i>Celtis philippinensis</i> Blanco		R	Chin 2100
Urticaceae			
<i>Debregeasia squamata</i> King ex Hook.f.		U	Ridley s.n. 1897
<i>Dendrocnide stimulans</i> (L.f.) Chew	E		Ridley 8527
<i>Elatostema curtisii</i> (Ridl.) H.Schrot.			Ridley 4717, 8196
<i>Elatostema latifolium</i> (Blume) H.Schrot.			Ridley 8200
<i>Elatostema repens</i> (Lour.) Hallier f.			Ridley 8186
<i>Nothocnide mollissima</i> (Blume) Chew			Ridley s.n. 1920
<i>Oreocnide rubescens</i> (Blume) Miq.			Ridley 8242; Sinclair SFN 40069; Omar FMS 7995
<i>Pilea fruticosa</i> Hook.f.	E	R	Ridley 8526; Ding DH 720
<i>Poikilospermum cordifolium</i> (Barg.-Petr.) Merr.			Mohd Nur 8962
Violaceae			
<i>Rinorea horneri</i> (Korth.) Kuntze			Chin 338
Vitaceae			
<i>Cayratia wrayi</i> (King) Gagnep.			?Ridley
<i>Cissus hastata</i> Miq.			Whitmore FRI 15629

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<i>Cissus javana</i> DC.		R	Chin 1755
<i>Cissus nodosa</i> Blume			Ng FRI 1631; Ding DH 711
<i>Leea indica</i> (Burm.f.) Merr.			Chin 476
<i>Leea saxatilis</i> Ridl.	E	U	Ridley 305, Merton 4098
<i>Tetrastigma leucostaphylum</i> (Dennst.) Alston ex Mabb.			Ridley
<i>Tetrastigma pedunculare</i> (Wall. ex Lawson) Planch.			Chin 789
<i>Tetrastigma scortechinii</i> (King) Gagnep.	E		?Curtis
Araceae			
<i>Alocasia inornata</i> Hallier f.			Ridley 8168; Herscovitch 940101; Hay 9057
<i>Alocasia longiloba</i> ‘lowii’		R	Ridley s.n.; Sinclair 40071
<i>Apoballis mutata</i> (Hook.f) S.Y.Wong & P.C.Boyce			Ridley s.n.
<i>Homalomena griffithii</i> (Schott.) Hook.f.			Nicolson 1155
<i>Homalomena humilis</i> (Jack) Hook.f.			Ridley s.n. 1889
<i>Pothos leptostachyus</i> Schott.		R	Ridley s.n.
<i>Rhaphidophora burkilliana</i> Ridl.	E	R	Mohd. Nur 8965
<i>Rhaphidophora montana</i> (Blume) Schott.		R	Ridley s.n. 1889
<i>Schismatoglottis calyptrata</i> (Roxb.) Zoll. & Moritzi			Ridley s.n. 1889
<i>Scindapsus hederaceus</i> Miq.			Ridley s.n.
<i>Scindapsus perakensis</i> Hook.f.			Ridley s.n.
<i>Typhonium fultum</i> Ridl.	ET	R	Ridley 8165
Convallariaceae			
<i>Peliosanthes teta</i> Andrews			Sinclair SFN 40059
subsp. <i>humilis</i> (Andrews) Jessop			
Dracaenaceae			
<i>Dracaena</i> sp.			Saw FRI 48224
Gramineae			
<i>Dichanthium mucronulatum</i> R.K.Jansen	E	R	Ridley 8129; Chin 1271
<i>Echinochloa colona</i> (L.) Link			Duistermaat FRI 51920
<i>Eleusine indica</i> (L.) Gaertn.			Duistermaat FRI 51922
<i>Eragrostis pilosa</i> (L.) P.Beauv.			Duistermaat FRI 51925
<i>Eragrostis amabilis</i> (L.) Wight & Arn. ex Hook. & Arn.			Duistermaat FRI 51924
<i>Oplismenus compositus</i> (L.) P.Beauv.			Duistermaat FRI 51916
<i>Sporobolus indicus</i> (L.) R.Br. var. <i>flaccidus</i> (Roem. & Schult.) Veldkamp			Duistermaat FRI 51921
Orchidaceae			
<i>Adenoncos parviflora</i> Ridl.			Kelsall s.n. 1891
<i>Adenoncos sumatrana</i> J.J.Sm.			Ridley 8171
<i>Appendicula anceps</i> Blume			Saw FRI 48228
<i>Bulbophyllum flammuliferum</i> Ridl.	E	R	Ridley s.n.
<i>Calanthe ceciliae</i> Reichb.f.			Ridley 8486
<i>Calanthe vestita</i> Lindl.		R	Ridley s.n. Dec 1896; Strugnell FMS 17077
<i>Corybas calcicolus</i> J. Dransf. & G.Smith	E	R	Chin 355; Dransfield s.n. 1970
<i>Corymborkis veratifolia</i> Blume			Ridley 8128
<i>Dendrobium subulatum</i> (Blume) Lindl.			Ridley s.n. 1894
<i>Goodyera pusilla</i> Blume		R	Symington FMS 30776
<i>Grosourdia appendicula</i> (Blume) Reichenb.f.		U	Ridley s.n. 1897
<i>Oberonia sinuosa</i> Ridl.			Ridley s.n.
<i>Pennilabium angraecum</i> (Ridl.) J.J.Sm.	E		Ridley 8131
<i>Pholidota imbricata</i> Hook.		U	Ridley s.n. 1897
<i>Phreatia plantaginifolia</i> (K.D.Koenig) Ormerod			Ong FRI 67738
<i>Polystachya concreta</i> (Jacq.) Garay & H.R.Sweet			Saw FRI 48229; Ong FRI 71387
<i>Pomatocalpa andamanica</i> (Hook.f.) J.J.Sm.		R	Chin 1244
<i>Renantherella histriconica</i> (Reichb.f.) Ridl.			Chin 1264
<i>Schoenorchis micrantha</i> Blume			Ridley s.n 1896
<i>Taeniophyllum filiforme</i> J.J.Sm.			Ridley s.n. 1896
<i>Thelasis pygmaea</i> Blume			Ridley s.n. 1896, 8465
<i>Trichoglottos retusa</i> Blume		U	Kelsall s.n.
<i>Ventricularia tenuicaulis</i> (Hook.f.) Garay		U	Ridley 8133



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Palmae			
<i>Calamus manan</i> Miq.			Loh FRI 21521
<i>Calamus scipionum</i> Lour.			Tahir FRI 18537
<i>Iguanura wallichiana</i> (Wall. ex Martelli) Hook.f.			Kiew, B.H. RK 1345
<i>Maxburretia rupicola</i> (Ridl.) Furtado	E	R	Ridley 8285; Whitmore FRI 15636; Saw FRI 48227
<i>Oncospermum horridum</i> (Griff.) Scheff.			Chin, S.C. obs.
Pandanceae			
<i>Pandanus penangensis</i> Ridl.	E	U	Whitmore FRI 15625
Zingiberaceae			
<i>Alpinia javanica</i> Blume			Ridley s.n. 1889
<i>Amomum testaceum</i> Ridl.		U	Ridley 13122
<i>Etlingera littoralis</i> (J.Koenig) Giseke			Ridley s.n. 1890